FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION-2024 FOR RECRUITMENT

TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT

Roll Number

APPLIED MATHEMATICS

TIME ALLOWED: THREE HOURS **PART-I(MCQS): MAXIMUM 30 MINUTES**	**PART-I (MCQS) MAXIMUM MARKS = 20** **PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q. Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.

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Roll Number

APPLIED MATHEMATICS

TIME ALLOWED: THREE HOURS	MAXIMUM MARKS = 100

NOTE: **(i)** Attempt only **FIVE** questions in all. **ALL** questions carry **EQUAL** marks.
(ii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iii) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(iv) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(v) Extra attempt of any question or any part of the attempted question will not be considered.
(vi) **Use of Calculator is allowed.**

Q. No. 1 **(a)** Expand a fourier series of $f(x) = x^2,\ \ 1 < x < 2$ **(10)**

(b) Find equation of integral surface of the differential equation $2y(z-3)p + (2x-z)q = y(2x-3)$ which passes through the circle $x^2 + y^2 = 2x,\ z = 0.$ **(10)**

Q. No. 2 **(a)** Solve the higher order differential equation $y'''' + y'' = 3x^2 + 4Sinx - 2Cosx$ **(10)**

(b) Solve the initial value problem $y'' - 8y' + 15y = 9xe^{2x},\ \ y(0) = 5,\ y'(0) = 10$ **(10)**

Q. No. 3 **(a)** Solve the equation $4u_{xx} + 5u_{xy} + u_{yy} + u_x + u_y = 2$, also find its canonical form. **(10)**

(b) Prove that $\int_{-1}^{1} x^n P_n(x)dx = \frac{2^{n+1}(n!)^2}{(2n+1)!}$, where $P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2-1)^n$ is Legender polynomial of degree n. **(10)**

Q. No. 4 **(a)** Verify the divergence theorem for $A = 4x\boldsymbol{i} - 2y^2\boldsymbol{j} + z^2\boldsymbol{k}$ taken over the region bounded by $x^2 + y^2 = 4$, $z = 0$ and $z = 3$. **(10)**

(b) State and prove Stoke's theorem. **(10)**

Q. No. 5 **(a)** Using the modified Euler's method, obtain the solution of the differential equation **(10)**

$$\frac{dy}{dt} = t + \sqrt{y} = f(t,y)$$

with initial condition $y_0 = 1$ at $t_0 = 0$ for the range $0 \le t \le 0.6$ in step of 0.2.

(b) Find the real roots of equation $4x + Cosx + 2 = 0$ by using Newton Raphson method, correct to four decimal places. **(10)**

Q. No. 6 **(a)** Solve the system of linear equations by Guass-Seidel iterative method and perform the first three iterations of **(10)**

$$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$

(b) Solve the following Van der Pol's equation $y'' - (0.1)(1 - y^2)y' + y = 0$, using fourth order Runge-Kutta method for $x = 0.2$, with the initial values $y(0) = 1$, $y'(0) = 0$. **(10)**

Q. No. 7 (a) Find the law of force for a particle moving in an orbit, $r = \frac{l}{1 - eCos\theta}$, where l is semi latus rectum and e is eccentricity. **(10)**

(b) Prove that the speed required to project a particle from a height h to fall a horizental distance a from the point of projection is at least $\sqrt{g(\sqrt{a^2 + h^2}) - h}$. **(10)**

Q. No. 8 (a) Find the radial and transvers components of velocity moving along a curve $ax^2 + by^2 = 1$ at any time t if the polar angle $\theta = ct^2$. **(10)**

(b) Find the centroid of the surface formed by the revolution of the cardioide $r = a(1 + Cos\theta)$ about the initial line. **(10)**

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